A Citizen's Guide to Rocky Flats

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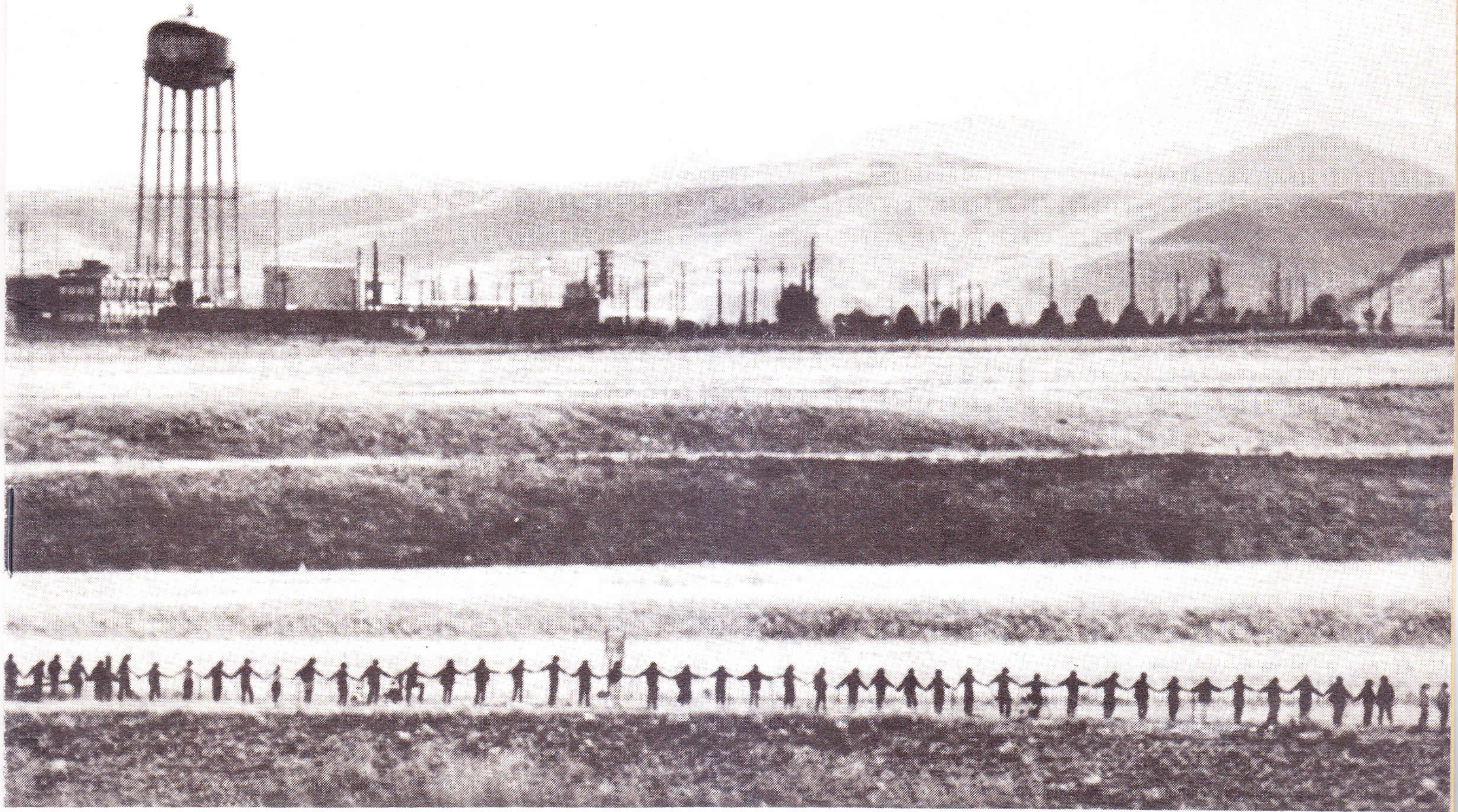
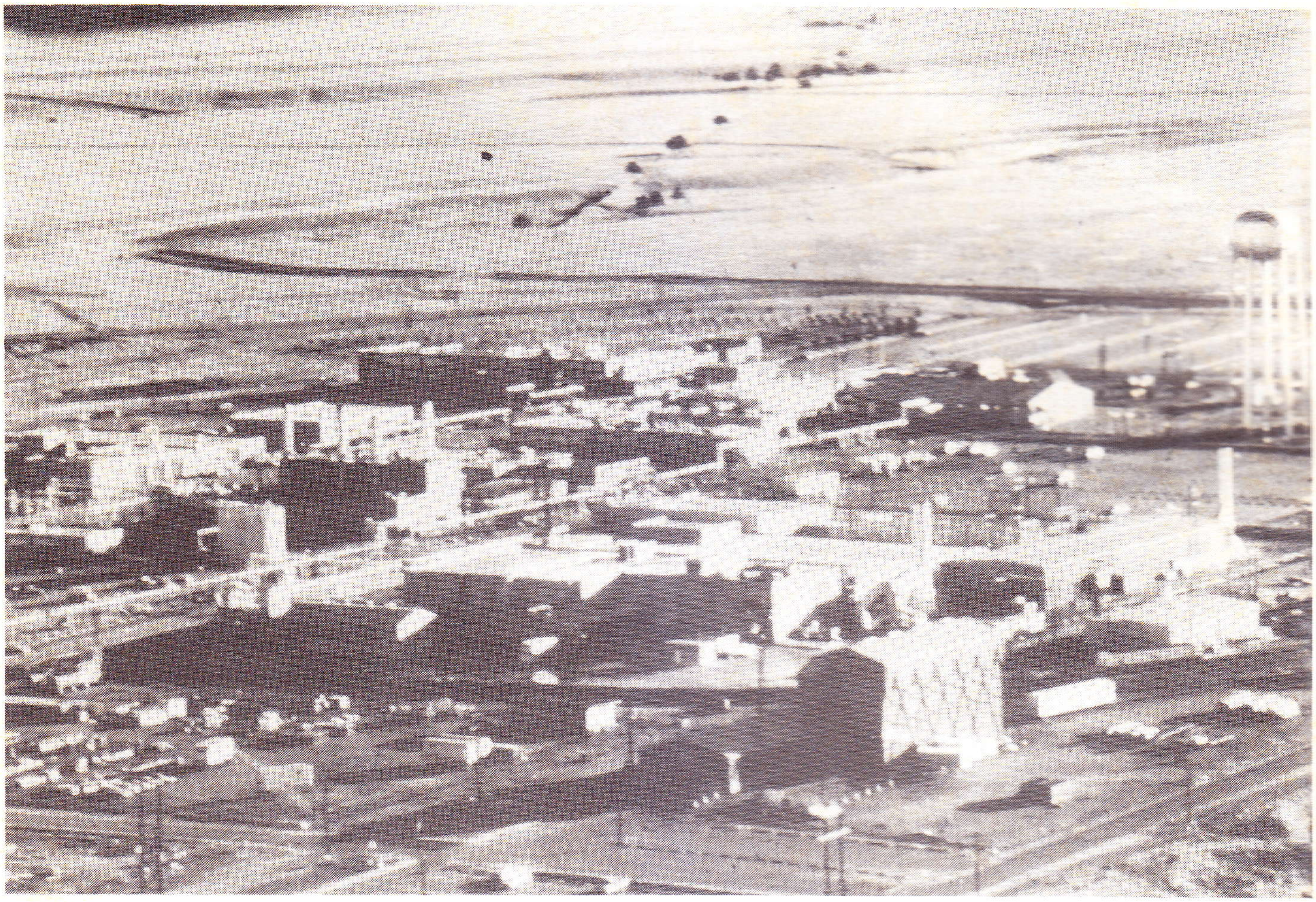
Environmental and Safety Issues At the Nuclear Weapons Plant

By Marcia Klotz



Published By Rocky Mountain Peace Center



Aerial view of Rocky Flats

Published, June 1988 by the Rocky Mountain Peace Center, P.O. Box 1156, Boulder CO 80302; ph.: (303) 444-6981. Reproduction, with citation, of any material from this pamphlet is authorized and encouraged.

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Printed in Boulder by Intermountain Color; cover by Preferred Printing.

Additional copies of this pamphlet and information about political action concerning Rocky Flats are available from the Rocky Mountain Peace Center.

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A Citizen's Guide to Rocky Flats

"There's Good News Today. U.S. To Build $45 Million A-Plant Near Denver." This *Denver Post* headline of March 23, 1951, announced the birth of what was to become the only plant in the United States to manufacture plutonium triggers for hydrogen bombs. It also marked the beginning of a highly complex, forced relationship between a U.S. nuclear facility, the workers who staff it, and more than a million residents of the nearby metropolitan area.

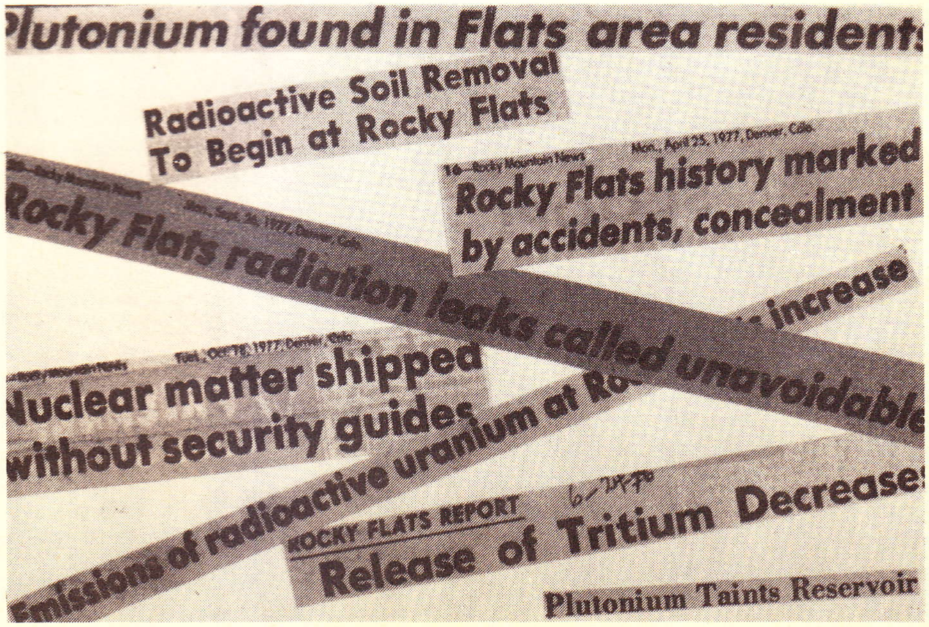
Mass production of nuclear weapons was a new concept in 1951. The Los Alamos facility had served both the research and production needs of U.S. nuclear development up to that time. In order to allow Los Alamos to concentrate strictly on research, the Atomic Energy Commission (AEC) was developing a complex of facilities across the nation to build nuclear weapons.

The AEC's criteria for choosing a site included a western location; a dry, moderate climate; a dependable power source; the proximity of a population of 25,000 or more; and an attractive environment. Rocky Flats was chosen over 35 other sites.

To avoid a public health risk resulting from a nuclear accident, the AEC needed a location downwind of any dense population. The Rocky Flats site seemed safe because wind measurements at Stapleton International Airport showed prevailing air currents blowing from the south, from Denver towards Rocky Flats. These initial readings were incorrect. Winds coming from the mountain canyons to the west of the plant do not follow the same patterns as those at the airport. In general, air currents leaving Rocky Flats blow to the east or southeast — often towards downtown Denver.

The AEC originally contracted with the Dow Chemical Company to operate Rocky Flats. The facility's contract passed from Dow to Rockwell International in July 1975. That same year, administrative authority also shifted from the AEC to the Energy Research and Development Administration (ERDA). The Department of Energy (DOE) replaced ERDA in 1977 and has regulated the plant since then.

Rocky Flats has grown significantly since it began full-scale operations in 1953. The original $45 million price tag mushroomed into construction expenditures of $250 million. U.S. taxpayers now pay $450 million each year to operate the plant. Rockwell International's work force has grown to over 5200 (as of February 1988) from Dow's initial payroll of 200. And more than 100 buildings now occupy a site that started out with only 20 structures.



lutonium found in Flats area resident

Radioactive Soil Removal To Begin at Rocky Flats

Rocky Flats history marked by accidents, concealment

Rocky Flats radiation leaks called unavoidabl

increase

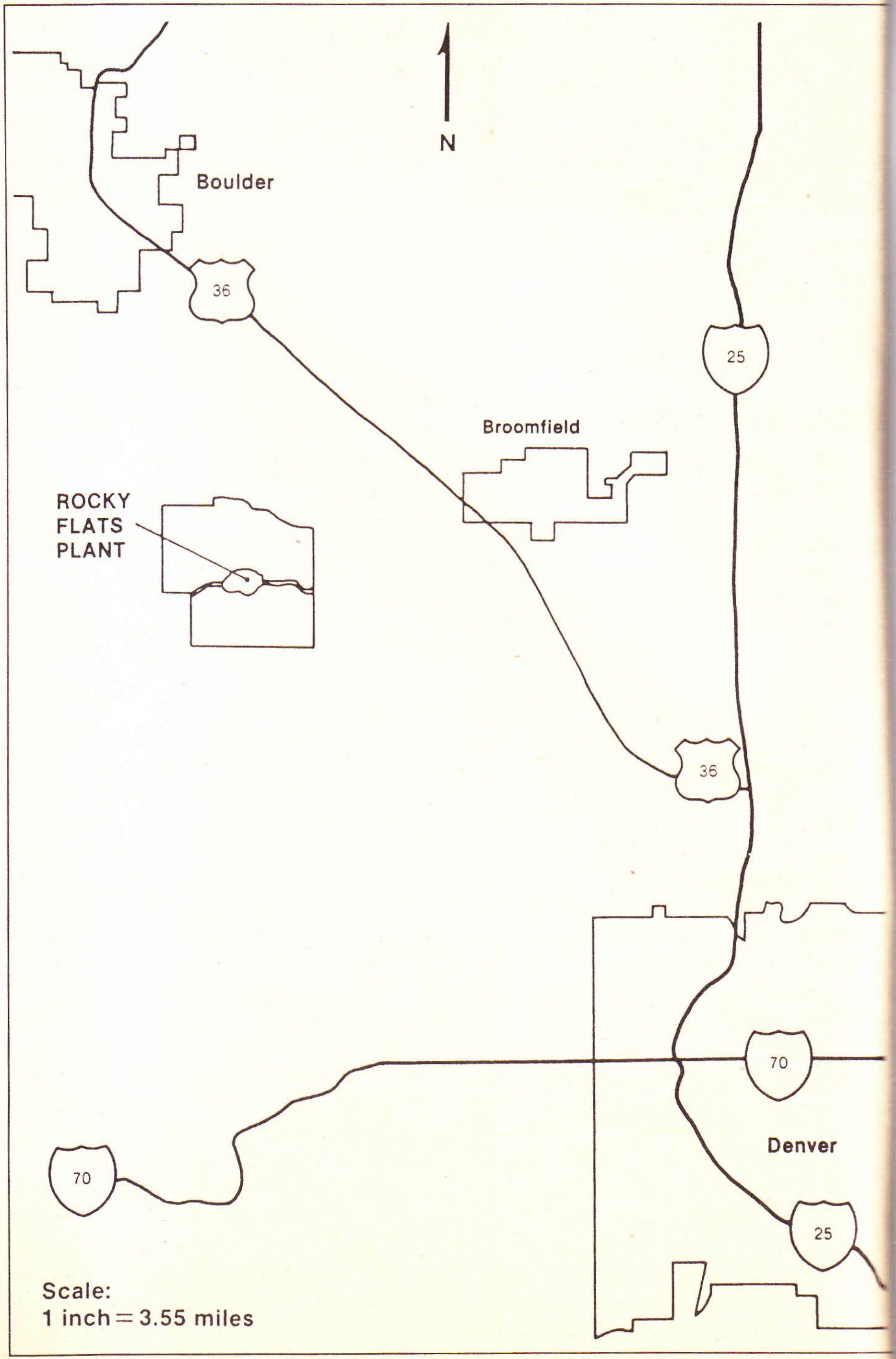
uclear matter shipped without security guides

Emissions of radioactive uranium at Ro

ROCKY FLATS REPORT
Release of Tritium Decrease

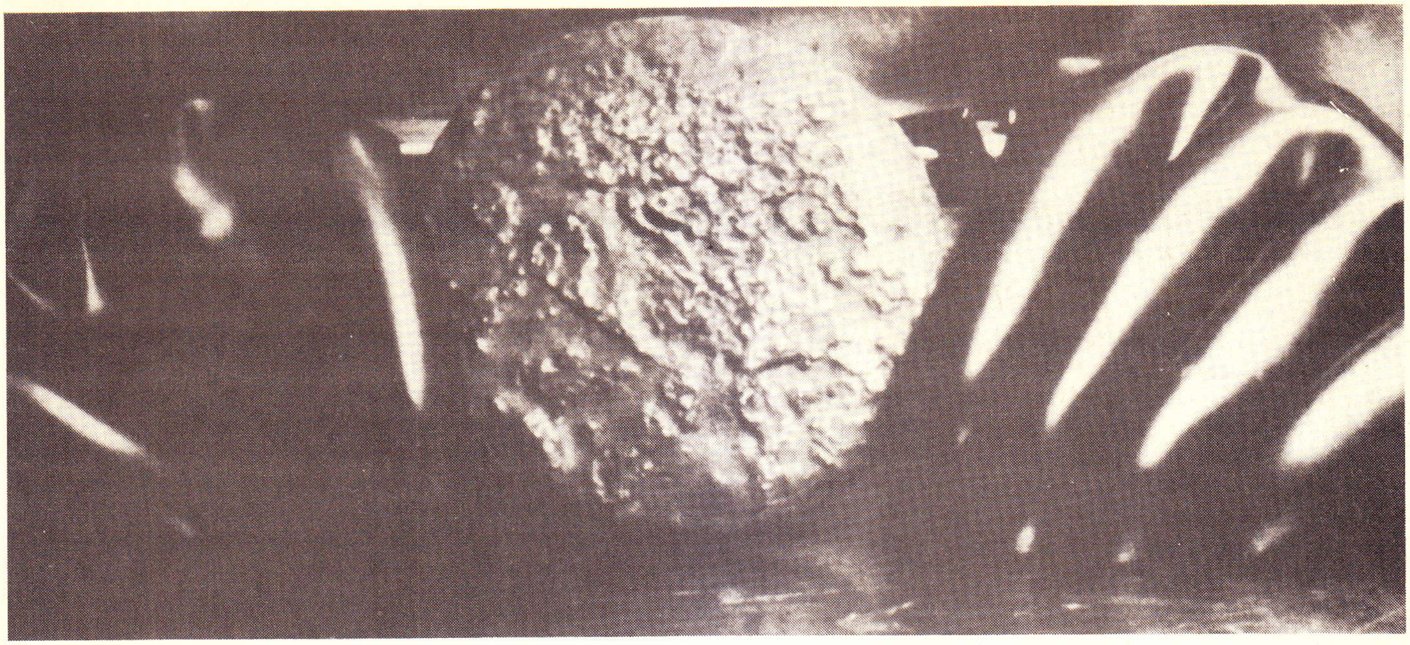
Plutonium Taints Reservoir

Rocky Flats has grown significantly since it began full-scale operations in 1953. The original $45 million price tag mushroomed into construction expenditures of $250 million. U.S. taxpayers now pay $450 million each year to operate the plant. Rockwell International's work force has grown to over 5200 (as of February 1988) from Dow's initial payroll of 200. And more than 100 buildings now occupy a site that started out with only 20 structures.



Rocky Flats Plant and Surrounding Area

Source: Final Environmental Impact Statement, Rocky Flats Plant (April 1980)



This buttton of plutonium weighs ten pounds. This is the form in which it is shipped to Rocky Flats from Hanford and Savannah River. It is then machined into triggers. More than a ton of plutonium is "missing and unaccounted for" according to the General Accounting Office.

Rockwell International

Rocky Flats is a small part of Rockwell's total operations. With $12 billion in 1986 sales, derived mostly from aerospace, electronics and automotive businesses, Rockwell employs about 25,000 scientists, engineers and technicians, roughly 10% of whom work at Rocky Flats.

Rockwell's financial contribution to the Denver area is substantial. Not only does it pay $280 million in annual wages and benefits to Rocky Flats employees, but the corporation also spent $65 million in 1986 purchases in the Denver region.

The DOE grants Rockwell 1.5 percent profit on Rocky Flats' annual operating budget — about $ 7 million. Rockwell also acquires the rights to inventions stemming from Rocky Flats operations. In addition, the plant serves as a training ground to develop technological expertise in handling plutonium, valuable knowledge for some of the corporation's other operations. Rockwell garners additional profit from research and manufacturing done for third parties at the plant.

Stockholders at Rockwell's annual meeting in 1987 proposed a "Rocky Flats Action Plan" that called upon Rockwell to stop producing radioactive waste and to remove contamination from the surrounding land. The board of directors opposed the proposal. It was defeated, but with 8% of the votes in favor. [2]

The Two Missions of Rocky Flats

Rocky Flats is a critical link in the nuclear weapons production chain. It serves two major purposes in the fabrication line: the manufacture of nuclear components for weapons and the reprocessing of obsolete and unreliable weapons.

Trigger Production

Rocky Flats imports plutonium — a radioactive, heavy metallic element that is one of the most toxic elements known to humanity. Plutonium does not exist in nature, but is made by bombarding uranium with slow neutrons. Once created, plutonium poses an ongoing threat to the health of many generations because it has a half-life of 24,000 years.*

The Department of Energy's nuclear reactors in Hanford, Washington and Savannah River, South Carolina produce plutonium. Workers at these facilities extract plutonium from nuclear power plant fuel rods, concentrate it, form it into ten-pound buttons, and ship it to Rocky Flats. Here, the raw plutonium is machined into triggers — fission bombs used inside a hydrogen bomb to generate a sufficiently high temperature and density to set off a fusion reaction. The H-bomb itself is inherently clean; all the radioactive fallout comes from the plutonium trigger.

Rocky Flats workers ship the completed triggers by truck to the Pantex nuclear weapons facility in Amarillo, Texas, where they are assembled into finished weapons.

The process of manufacturing nuclear bombs also produces plutonium-rich residues. Since plutonium is extremely costly, Rocky Flats operators save these residues to reclaim the plutonium. Residue purification takes place in buildings 371 and 771, using dry, heated chemicals (pyrochemical reprocessing) or acids (aqueous reprocessing).[1]

Processing Retired Weapons

As nuclear bombs age, they become unreliable. Older warheads are retired after a number of years; the time depends on the type of weapon. These, along with obsolete bombs, are sent to the Pantex Plant to be dismantled. The triggers are then transported back to Rocky Flats, where workers disassemble them, remove the plutonium and purify it for reuse in new bombs. The figure on page 11 charts the progress of plutonium from its birth in the reactors of Savannah River and Hanford to the final production of nuclear weapons at Pantex.

** All words followed by an asterisk appear in the glossary.*

Major Fires at Rocky Flats

When plutonium comes into contact with air, it ignites spontaneously, smoldering like charcoal. Because of this danger, workers manipulate plutonium with heavy rubber gloves through airtight, nitrogen-filled gloveboxes.

But sometimes gloveboxes develop leaks, allowing infiltrating air to ignite the plutonium within. This is probably what led to the explosion and fire at Rocky Flats on Sept. 11, 1957.[3]

One of the plant protection workers who discovered the fire later described what happened: "There was an explosion that nearly knocked me to the floor and blew all the doors on the west hall wide open. . . . I then heard Owen shout that it had blown up and for everyone to get out."

As firefighters tried to combat the blaze, filters over the glove box caught fire, releasing the plutonium particles lodged in them. Since these had not been changed since their installation in 1954, the filters alone may have released as much as 100 pounds of plutonium into the atmosphere on that day.

Attempts to quell the fire by turning on ventilation fans only spread the flames to more plutonium. About 40 pounds of the deadly substance burned in the blaze. When carbon dioxide also failed to extinguish the fire, plant officials decided to try water.

That decision entailed tremendous risk. It was thought that plutonium, mixed with water in a contained environment, could reach a critical mass, leading to a nuclear chain reaction known as criticality.

Though gravely dangerous, the use of water did eventually extinguish the fire some thirteen hours later. During the crisis, Rocky Flats personnel gave no warning to local schools, county commissioners, neighboring cities, or health agencies. No emergency actions were taken to protect the public.

Officials did not reactivate smokestack monitors until seven days after the accident. The first day they were turned on, the stack emissions measured were 16,000 times acceptable radiation standards.

Production resumed three days after the fire, although the destroyed filters had not yet been replaced.

In two elementary schoolyards, soil samples showed concentrations of "possible enriched uranium" about 200 times the background level in Colorado from nuclear testing fallout. In spite of such alarming preliminary findings, Rocky Flats officials only examined three soil samples from the surrounding area.

Many smaller fires and accidents at Rocky Flats have resulted in worker contamination. An explosion in 1965, for example, resulted in such severe plutonium exposure of a worker's fingers that the thumb and second finger had to be amputated.[4]

Twenty plutonium fires broke out in 1969, the largest in May, when plutonium again ignited spontaneously in a cabinet. Heat sensors did not detect the fire until it was out of control, because workers had inadvertently insulated the sensors from the area in which the fire started.

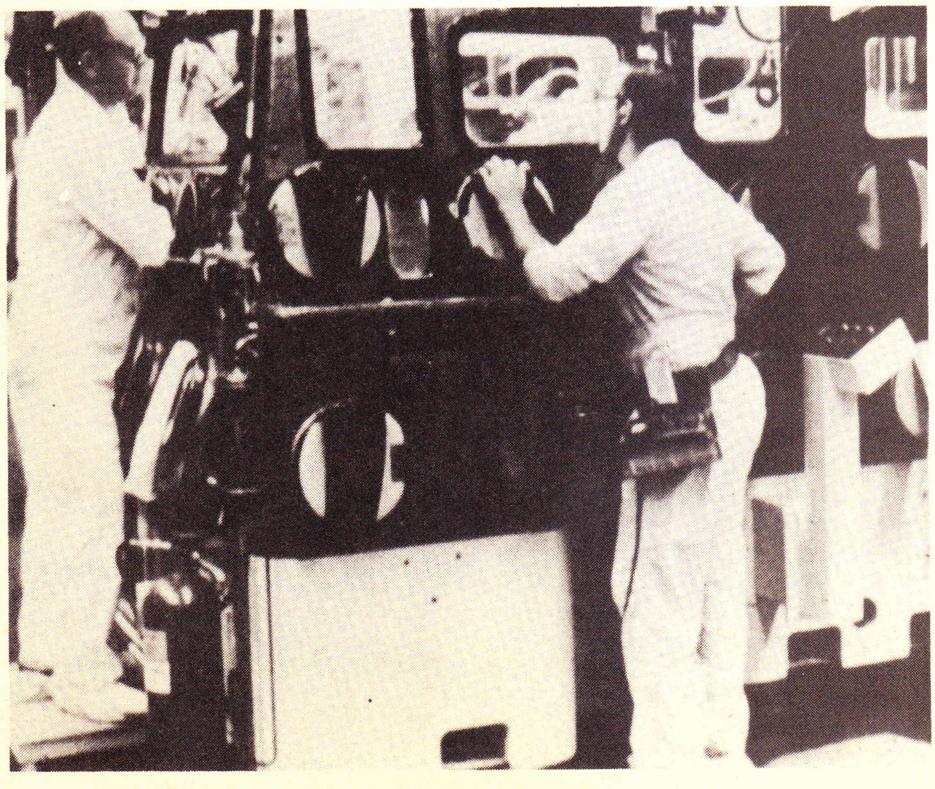
Firefighters exhausted carbon dioxide supplies in ten minutes. Water was again used to combat the blaze, and in four hours the fire was under control.

After the 1969 fire, scientists monitoring the soil around Rocky Flats found radioactive cesium-137 in samples up to 31 times background levels.[5] The presence of cesium, a fission product, indicates that the use of water on one of the two fires may have resulted in a nuclear chain reaction. Cesium might also have been released if nuclear fuel rods stored at the plant had burned in the fires.

The 1969 fire won the ignominious distinction of being the most expensive U.S. industrial accident of the time, costing taxpayers $45 million. The hundreds of workers needed to clean up the mess may be paying an even higher price.

According to Mrs. June Suttie, widow of a Rocky Flats employee who worked for months cleaning up after the fire, workers wiped off contaminated floors, ceilings, walls, and pipes with rags. When one janitor refused to take part, he was fired.[4] Mrs. Suttie believes her husband's work in those years exposed him to radioactivity, which contributed to the colon cancer that claimed his life in 1986.

How many of David Suttie's co-workers from the 1969 fire cleanup have also contracted cancer? Only the DOE can say. No other agency has the authority to perform a statistical study of cancer incidence in those workers. The DOE has plenty to lose from this type of study since a high correlation could lead to a greater number of worker lawsuits and a loss in reputation. As one might expect, the DOE has not done such a study and has no plans for one in the future.



Glove boxes in which the workers are manipulating plutonium. The inside of the boxes are normally at a lower pressure than the room outside to prevent contamination of the room in case of a leak.

Waste drums containing radioactive hazardous chemicals piled haphazardly at Rocky Flats. For more than ten years waste drums leaked onto the soil and into the air. Drums were removed in 1966.

Contamination

When plutonium burns or corrodes, it combines with oxygen to form plutonium dioxide, or PuO_2. Particles of this compound are small enough to be carried by wind currents. The majority of PuO_2 particles released by the fires of 1957 and 1969 are so small they can be inhaled easily. Since plutonium dioxide particles are highly insoluble, they do not percolate into the soil with rain, but remain on the surface for many years, where wind can again whisk them up.

According to scientist Edward Martell of the National Center for Atmospheric Research (NCAR), "the resuspension of deposited PuO_2 by the action of winds, vehicular traffic, and human activity gives rise to an inhalation hazard to occupants of the contaminated and downwind areas."[6]

Resuspended particles, along with the particles released by standard operations at Rocky Flats, create a substantial plutonium concentration in the air around the plant. Between 1970 and 1977, DOE air monitors showed a higher level of plutonium at Rocky Flats than at any of the other fifty U.S. monitoring sites for every year measured.[7]

New Onsite Contamination Studies

The DOE began a Rocky Flats cleanup project in 1984 known as the Comprehensive Environmental Assessment and Response Program (CEARP) for some contaminated areas on the Rocky Flats site.[8] In the first of five phases of this program, DOE investigated eighty potential environmental problems and found the condition of three areas serious enough to qualify for the Superfund National Priorities List. Just a few of the most alarming findings are discussed below:

The 903 Drum Storage Area

Between 1954 and 1966, Dow Chemical stored over 5000 drums in an open field on the Rocky Flats site, most of which contained spent machine cutting oil contaminated with plutonium. Dow officials discovered that some of these drums were leaking in 1959, but did nothing to correct the problem for seven years."[9]

Dow removed the drums in 1966 and sent the radioactive contents offsite for disposal. Workers then gathered the underlying contaminated soil into about three acres and covered it with asphalt in 1969. This was a very temporary solution — plutonium has a half-life of more than 24,000 years, while asphalt does well to last a century.

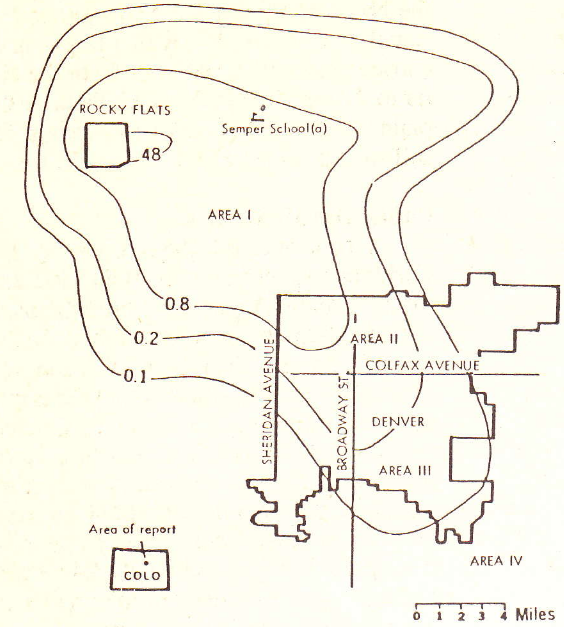
The 903 Lip Area

After the barrels were removed from the 903 Drum Storage Area, the plutonium-laced oil that had leaked into underlying soil was exposed to open air. Winds redistributed contaminated particles over what is now known as the 903 Lip Area, between the asphalt pad and the Rocky Flats boundary. Almost five million pounds of contaminated soil had to be shipped away from this area for disposal in 1978.

But plutonium particles do not stop at fences. When two NCAR scientists studied offsite soil samples in 1971, they discovered plutonium concentrations ranging from "250 times fallout at a distance of two miles east of the plant to ten times fallout in Westminster, eight miles east of the plant and to several times fallout in the eastern suburbs of Denver."[10]

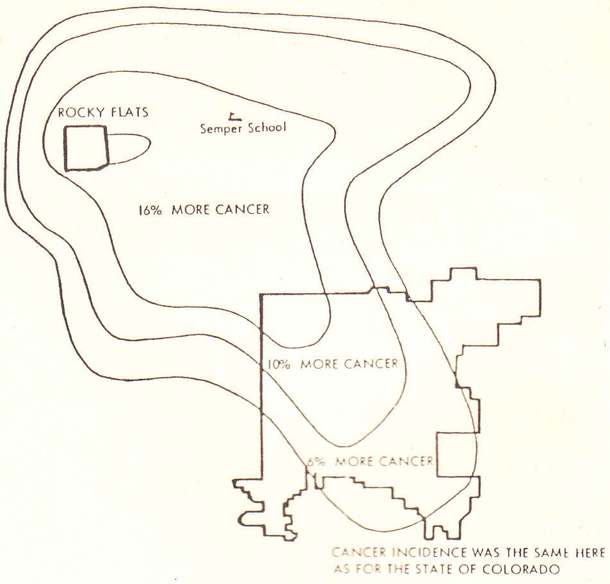
Subsequent investigations showed the plutonium had not been deposited by the two major fires, as originally assumed. Winds had carried the contamination offsite between 1967, when the oil drums were

DENVER AREA CENSUS TRACTS WITHIN ISOPLETHS FOR SOIL CONTAMINATION WITH PLUTONIUM DOWNWIND FROM THE ROCKY FLATS PLANT



ISOPLETHS IN MILLICURIES OF PLUTONIUM PER SQUARE KILOMETER

CANCER INCIDENCE IN 1969 - 1971



moved, and July of 1969, when the 903 Drum Area was paved.

If these scientists had not done independent soil samples, the public would never have learned about the leaking drums.

◆

Uranium Incineration Pits

Oil containing uranium chips was burned in open pits in various areas on the Rocky Flats site from 1954 to 1968. This unfiltered incineration not only endangered downwind residents by spewing radioactive particles into the air but also left many contaminants in the soil. In one instance, plant personnel constructed a building over a burn pit; in others, they covered the pits with backfill.

Surface Water

Between 500 and 2000 curies* of tritium, a radioactive hydrogen isotope, were released with waste water from Rocky Flats in 1973. Plant workers were unaware that a shipment of scrap plutonium received from the Lawrence Livermore Laboratory in California also contained tritium. No attempts were made to recover the tritium from the scrap because nobody knew of its existence, so it was released into the liquid waste stream. Some of it wound up in Walnut Creek, which flows into the Great Western Reservoir, the water supply for Broomfield. State health department officials, alarmed at peaking tritium levels in the Broomfield water supply, eventually traced the contamination back to Rocky Flats.

Because of the tritium release, a task force appointed by Governor Richard Lamm and then-Representative Tim Wirth in 1975 recommended that "federal and local authorities supply an alternate source of water to Broomfield until the Great Western Reservoir is no longer subject to potential contamination from Rocky Flats."[9]

A secondary water source now exists for Broomfield, but the Great Western Reservoir still serves as the primary source. Meanwhile, the Walnut Creek drainage area has earned top ranking on the list of high-risk areas at Rocky Flats.

The Woman Creek Drainage

Woman Creek, which runs through Rocky Flats and into Standley Lake, is also in danger of serious contamination. Just two miles southeast of the plant boundary, Standley Lake supplies part of the water needs of Westminster, Northglenn, and Thornton. Hillside 881, located in the Woman Creek drainage area, is contaminated with hazardous chemical and possibly radioactive substances. In high rain seasons, pollutants from Hillside 881 could spill into Woman Creek, eventually contaminating local water supplies. Because of this risk, Rockwell has chosen Hillside 881 as the first cleanup site in the CEARP program, budgeting almost $40 million in the next two years on the hillside alone.[11]

An incomplete study of sediments in the Great Western Reservoir and Standley Lake showed levels higher than background of both plutonium and americium (a radioactive decay product of plutonium). A thorough study is yet to be done.[12]

Groundwater

A 1986 DOE study revealed high levels of volatile organic compounds in Rocky Flats groundwater. Eight onsite monitoring wells turned up four toxic chemicals in concentrations 1000 times EPA's maximum acceptable standards.[1]

As part of the CEARP cleanup program, officials have been investigating possible origins of the groundwater contamination by interviewing senior plant workers. These interviews have brought many past accidents and spills to light, including overflows of waste and holding tanks, broken sewage lines, and leaks in underground process waste tanks. Many of these spills released radioactive and hazardous chemical contaminants into the soil. In most cases, information on cleanup measures taken immediately after the accidents is incomplete. Once in the soil, little can be done to keep pollutants from percolating into the underlying aquifer.

Groundwater pollution at Rocky Flats could eventually result in the contamination of surface water and drinking supplies because the aquifer discharges to the surface in springs downstream of Rocky Flats. Rockwell, DOE, EPA, and state health department officials are currently examining the extent of the damage. Any corrective action is bound to be quite expensive. Options include:

- trying to contain the contaminated groundwater under Rocky Flats by limiting aquifer mobility;
- pumping neutralizing chemicals into the groundwater through wells; and
- pumping polluted groundwater to the surface for cleanup or storage.

Health Effects of Rocky Flats

Debate over the safety of the Rocky Flats facility and the health of the surrounding community has been raging for many years. Scientists have conducted two kinds of health studies pertaining to Rocky Flats: those examining workers at the plant and those monitoring the population of the Denver metropolitan area to see if any negative health effects, such as cancer incidence, increase with proximity to the plant. Such studies are important because they can help determine "safe" radiation exposure standards (in itself a disputed notion). Many of these studies present scientific difficulties, often generating statistical data that are difficult to interpret.

Plutonium Effects on the Human Body

Plutonium emits alpha particles, energetic particles that travel about five cell diameters in tissue. Skin effectively blocks alpha radiation from plutonium sources outside the body. But when plutonium enters the body by means of inhalation, ingestion through food or drinking water or through open wounds, the continuous emission of alpha particles can do great injury. Even though alpha particles only penetrate a small amount of tissue, they carry enough energy to kill the cells they encounter or to cause mutations that can result in cancer.

The amount of radiation given off by Rocky Flats plutonium does not remain constant, but increases with time. This is because some plutonium spontaneously disintegrates into americium, a much more active alpha particle emitter. After 70 years the radiation level will have increased by about 50 percent.

It is difficult for the human system to flush out plutonium. In fact, half of the original mass will still remain in the body a century after its entry.

When inhaled, plutonium particles are deposited in the lung. From there, they slowly migrate via the lymphatic system to the tracheobronchial lymph nodes. Over many months, plutonium is redistributed to other organs, principally the liver and bones.[13] Plutonium's tendency to concentrate in certain organs makes it more damaging than if it were evenly distributed throughout the body. Allowable exposure standards have often been set too high, assuming uniform distribution.

Chromosome Aberrations

The discovery of high levels of plutonium in the gonads has led to studies of chromosome aberrations.[14] One study shows that plutonium is ten times more effective in causing chromosome aberrations than in causing lung cancer.[15] And a study of 343 plutonium workers at Rocky Flats shows that those with plutonium deposits in body organs between one and ten nanocuries* had a chromosome aberration rate twice as high as those with less than one nanocurie of internal exposure.[16] The tendency of plutonium to concentrate in the gonads means that chromosomal damage can also be passed to the next generation.

Plutonium Releases from Rocky Flats

In the course of normal operations, Rocky Flats currently emits one or two microcuries* of plutonium per month.[17] In the entire operational history of the plant, this adds up to about one millicurie. But thousands of times more plutonium than this was released in the explosion and fire of 1957, the fire of 1969, and the leaks of the late sixties.

Plutonium from Rocky Flats has been deposited offsite in a broad tongue, sweeping to the southeast into Denver, following prevailing wind patterns. Some plutonium, traceable to Rocky Flats by its isotopic composition, has also been found as far away as Loveland, thirty miles north of the plant.

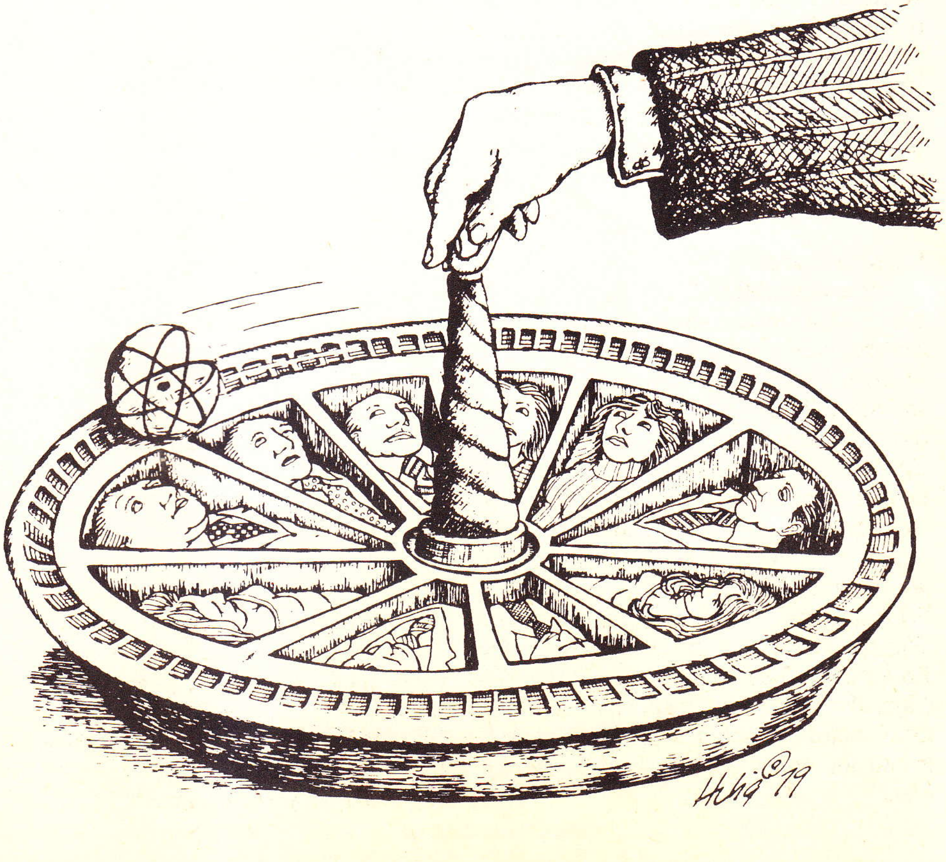
Soil studies can account for about twelve curies of plutonium released from the facility in the course of its history, about a fourth of which has been deposited on offsite land.[18] But this is only 1% of the plutonium lost in the 1957 fire alone. What happened to the rest? Dr. Edward Martell of the National Center for Atmospheric Research speculates that winds might have carried radioactive particles from the fire far to the east before dropping them on the plains of eastern Colorado and Kansas. No soil studies have been done in this area.

Public Health Studies

A controversial 1981 report by Dr. Carl Johnson, then director of the Jefferson County Health Department, brought much public attention to Rocky Flats' health impacts on the Denver area.[19] Johnson divided the region around Rocky Flats into areas of decreasing contamination, determined by previous soil studies (see figure on page 6). He then determined cancer incidence from 1969 through 1971 for these areas from federal data. Area I, the most contaminated region, showed a 24 percent higher cancer incidence in men and a 10 percent higher incidence in women over Area IV (the area of little to no contamination). Excess cancer incidence in Area II was 15 percent for men and 5 percent for women.

Johnson pointed out that most of the excess cancer cases, such as leukemia, lymph, lung, thyroid, testes and breast cancers, paralleled those of Hiroshima and Nagasaki survivors.

A 1987 study, funded by DOE, reanalyzed these data and found that "Johnson's



results were closely reproduced."[20] New data from 1979 through 1981 showed the same trend, except that the highest cancer rates now occurred in Area II. This could be explained by the large number of new residents moving into Area I, diluting the contaminated population by 50 percent.[21]

This DOE study also showed a relationship between proximity to the state capitol and an increase in cancer incidence, known as "urban effect." This finding does not negate Johnson's correlation of cancer incidence with plutonium contamination in the soil. Nevertheless, the authors state that the "study found no evidence of a relationship between the location of the Rocky Flats Plant and cancer incidence in the Denver area." This conclusion is not supported by the study's data.

Infant Deaths

Dr. Johnson also studied the health effects of Rocky Flats on children. He concluded that the infant mortality rate in Jefferson County, which had been lower than the national average before Rocky Flats began operating, rose sharply in the 1950's, peaking right around the time of the 1957 fire. Fetal death rates increased dramatically after the plant began operating, and the number of children dying of leukemia, which had been below the U.S. rate before 1953, grew to twice the national average after 1957.[22]

Worker Mortality Studies

In 1980, Johnson noticed a large number of brain tumors among Rocky Flats workers. Thirteen plant employees suffered brain tumors when only 1.6 were expected based on incidence in the general U.S. population.[23]

Johnson's findings prompted more research into worker health by a group of scientists from the Los Alamos National Laboratory, a DOE research facility. Their data confirmed a high number of brain tumors, but also noted that the overall rate of deaths observed at Rocky Flats from all causes was much lower than expected when compared with total deaths in the U.S. population.[24]

This finding can be explained by the "healthy worker effect," noted in other studies of industrial workers. The general U.S. populace is a biased comparison group because it contains many people who are unemployed for reasons of ill health. This fact, though mentioned in the study, was dismissed by a Los Alamos press release with the following headline: "Rocky Flats Mortality Study Means Less Worry for Plutonium Workers."[25] Rockwell went so far as to suggest that working at Rocky Flats was a particularly healthy activity.[26]

In 1987 the same group of Los Alamos health physicists published another study, using data on the same Rocky Flats workers but coming to the opposite conclusion.[13] Rather than comparing workers to the U.S. populace at large, this study divided workers into two groups: those exposed to less than two nanocuries of internal radiation and those exposed to two nanocuries or greater (the standard acceptable level of internal exposure at DOE facilities is forty nanocuries).

The exposed group showed a higher rate of death from all cancers, but particularly from those of the lymph system, esophagus, stomach, colon, and prostate. Cancer rates in the exposed group were higher than in the unexposed group by 1 percent after two years, 24 percent after five years, and 61 percent after ten years. Surprisingly, the cases of brain tumors, which had prompted these studies, occurred almost exclusively among the unexposed group.

Two nanocuries is the lowest amount of internal radiation that can be easily measured, given the accuracy of current instrumentation. The 1987 study shows that even at this low level, exposed workers developed cancer at a significantly higher rate than those who were not exposed — and in a much shorter period than most health physicists had previously assumed.

Radiation Standards

The task of setting limits to radiation exposure is very difficult, due to scientific and political hurdles. The Nuclear Regulatory Commission carries this responsibility, receiving recommendations from the National Council for Radiation Protection.

The fundamental limits are five rems* per year of occupational exposure and ten percent of that (1/2 rem per year) for the general public.

Just how much of a radioactive substance will result in five rems of exposure varies drastically, depending on the substance. The kind of radiation emitted, retention time and the tendency of the material to accumulate in certain parts of the body are all important factors. For example, five rems equals forty nanocuries of plutonium-239 (roughly a millionth of a gram), or 30,000 nanocuries of cesium-137, a beta emitter.*

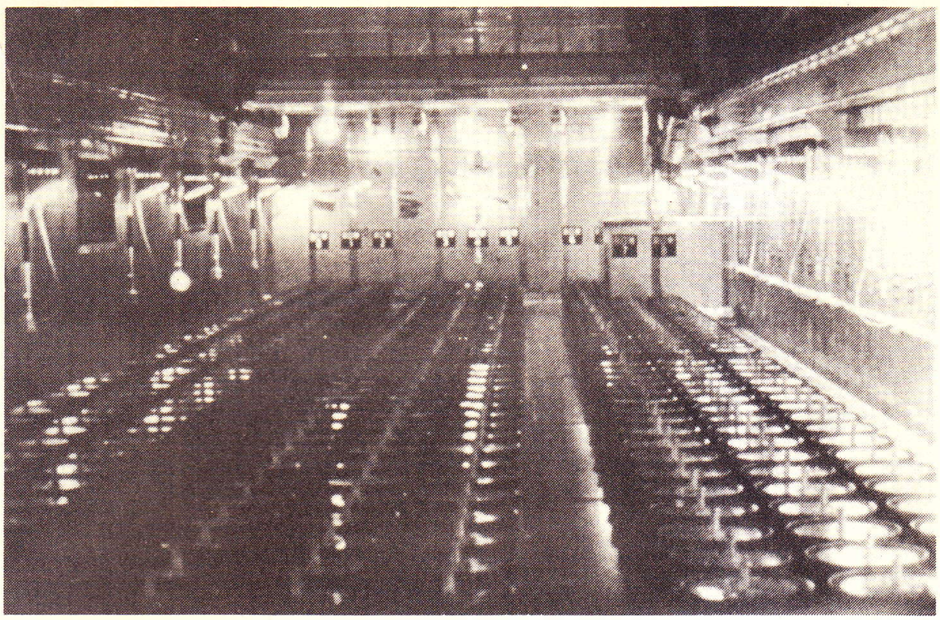
These limits are based on scientific studies, but it often takes a long time to incorporate new data into the standards. For example, a 1978 report noted that chlorine in public drinking water changes the chemical state of plutonium, making it about 1000 times more easily absorbed into the human body. The report's authors state, "The consequence of this observation is that the present values for the maximum permissible concentration of plutonium in drinking water appear to be too high by several orders of magnitude."[27] Ten years later, the standards remain the same.

An even more serious hazard involves the dangers posed by low levels of radiation, such as those encountered by workers at a weapons plant or people in the surrounding communities. Until recently, these have been extrapolated from models of high-level radiation by examining survivors of Hiroshima and Nagasaki. The inadequacy of this kind of modelling is amply demonstrated in the above-mentioned studies of Rocky Flats workers. While the maximum permissible body burden of plutonium is forty nanocuries, excess cancers were evident in workers exposed to only two nanocuries, one twentieth of the standard. Excess chromosome aberrations were evident at a fifth the standard.

A consistent trend is apparent in health research involving low-level radiation. Whenever new information leads to new standards, these are invariably lower than the old.

The political difficulties of setting radiation standards result largely from a conflict of interest within the DOE. The primary mission of the department is to produce nuclear weapons and promote nuclear energy. In this role, the DOE routinely contests court claims for radiation injury by people living near nuclear plants or test sites. Nevertheless, DOE funds over 60 percent of all research on the health effects of radiation and helps set radiation exposure standards.[28]

Some independent observers have noticed this conflict of interest and tried to correct it. President Carter formed an Interagency Task Force on Ionizing Radiation in 1979, which recommended that DOE's research program on the health effects of radiation be transferred to a federal public health agency.[29] Similarly, a report by Governor Richard Lamm's Health Assessment Group of 1984 recommended: "[F]uture research on the health of Rocky Flats workers should involve funding *independent* of the Department of Energy," and, ". . . the fact that [cancer] research will be funded by DOE will constitute a concern for those who worry about the potential for conflict of interest."[30]



Rows of drums containing plutonium ingots and parts are stored in this vault at Rocky Flats. The walls are ten inches thick. A computer controlled retrieval system handles traffic.

Accident Possibilities

Risk Analysis and DOE Conflict of Interest

Accidents of all sorts are a distinct possibility at Rocky Flats. Any of these could result in a substantial release of plutonium or other toxic materials into the environment. These include operational accidents (such as the major fires and spills of the past), earthquakes, high winds, tornadoes, sabotage, terrorist attack, and aircraft crashes into the plant. There are, however, serious difficulties in determining the possibility that such accidents will occur.

According to a DOE report, the possibility of natural disaster accounts for the vast majority of risk associated with the facility. "Earthquake and high-wind events severe enough to cause substantial building damage contribute approximately 93 percent of the composite risk due to the Rocky Flats Plant," reports the Long-Range Rocky Flats Utilization Study, published in 1983.[31] Many Rocky Flats structures were constructed when building codes regarding seismic and wind force resistance were less stringent than they are today. By modifying these buildings to meet current standards, risk associated with the facility could be reduced by 97 percent at a cost of $112 million., according to the study. Rockwell has chosen to make a simpler modification, costing $7.5 million and eliminating 93 percent of the risk.

The Long-Range Utilization Study offers a false sense of security by minimizing risk resulting from operational error while maximizing risk that can be easily corrected. A quick glance at the major industrial accidents of recent history, such as Three Mile Island, Bhopal and Chernobyl, shows that operator error and equipment malfunction have indeed proven the most dangerous components in overall risk at these facilities.

Since one can never predict all possible mistakes operators can make, one cannot prepare for them. Reinforced buildings will not eliminate the danger at Rocky Flats. Indeed, none of the major disasters at Rocky Flats has involved natural catastrophes, terrorists or aircraft.

This same DOE study estimates that each of the 1.8 million people living within a 50-mile radius of Rocky Flats faces only a 1-in-900 million chance of dying prematurely from a Rocky Flats accident. The study compares this risk with a Coloradan's 1-in-4000 chance of dying in a car accident or a 1-in-550 chance of dying of cancer, concluding that public risk associated with Rocky Flats operations is relatively insignificant.

This kind of risk assessment relies on an estimate of probability that has no historical basis. The study also ignores other possible hazards, such as the dangers of transporting plutonium to and from Rocky Flats or health hazards other than cancer. This is typical of DOE risk assessment studies, according to a 1981 General Accounting Office (GAO) report, which concluded that many DOE studies of nuclear facilities across the nation do not examine all potential risks.[32]

The DOE's primary objective is to promote, operate and regulate the nuclear bomb industry. So long as the department also sponsors these studies, one can expect risk estimates to be minimized, due to an obvious conflict of interest.

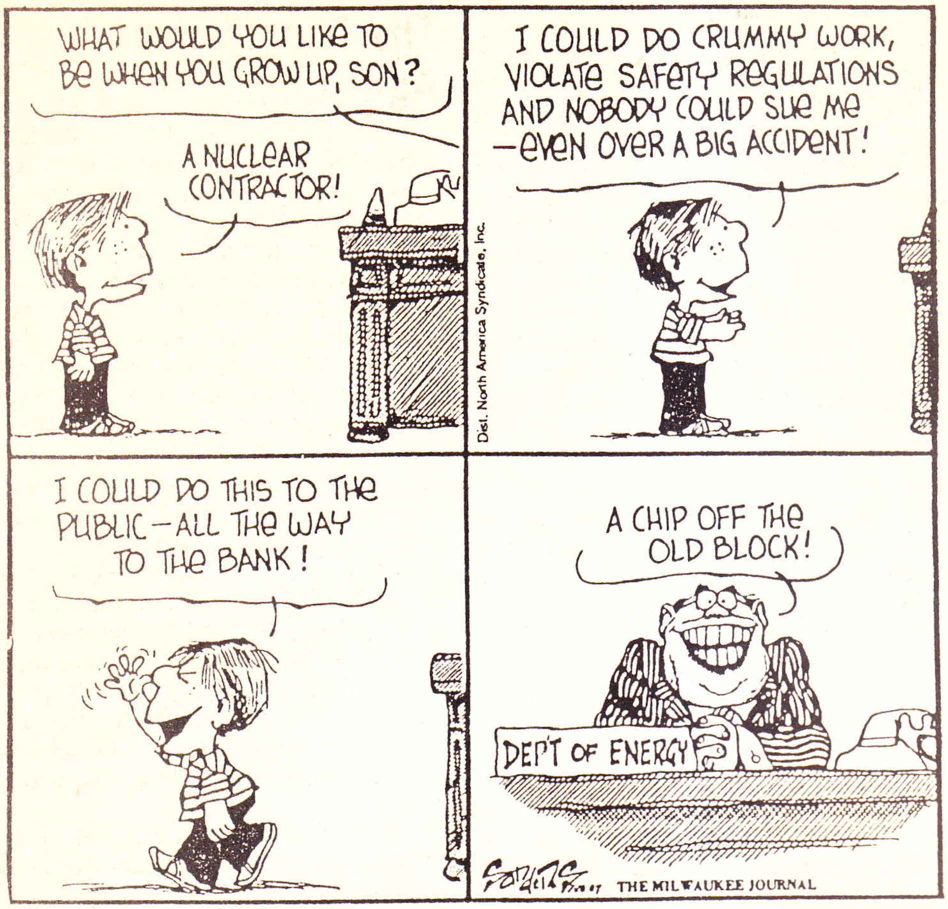
When the GAO reviewed a number of safety-related DOE reports in 1987, it concluded that "all safety analysis reports were being reviewed and approved internally within the DOE, which does not represent an independent review process." GAO recommended "an arrangement so that DOE's safety analysis reports receive outside, independent reviews." DOE disagreed with this recommendation.[33]

Advice to Homeowners

By no means do the realtors and developers of the Denver metro area share a unified position on Rocky Flats. Some developers have moral scruples about building on tracts near the plant, but others object even to warning prospective homeowners about the soil contamination around Rocky Flats.

In 1978 the EPA suggested that the Department of Housing and Urban Development (HUD) warn potential homeowners about the possibility of an accidental release of plutonium from Rocky Flats. HUD initially rejected the suggestion, stating that Rocky Flats operations "present no more hazard than many ordinary occurrences in daily life."[40] In March of 1979, however, HUD issued the Rocky Flats Advisory Notice, notifying prospective tenants and buyers of the existence of "varying levels of plutonium contamination of the soil." The advisory notice also mentioned an "Emergency Response Plan," which specified protective actions in case of an accidental release of radioactivity from the plant. Anyone applying for federal mortgage insurance for land within ten miles of Rocky Flats was required to read this notice.[41]

In January of 1981, under the new Reagan administration, the advisory notice was discontinued in favor of a Colorado state brochure, "Information regarding the Rocky Flats Radiological Emergency Response Plan." A year later this program was also abandoned. Today, prospective homeowners receive no advice or warning regarding the dangers of living near Rocky Flats.


WHAT WOULD YOU LIKE TO BE WHEN YOU GROW UP, SON?
A NUCLEAR CONTRACTOR!
I COULD DO CRUMMY WORK, VIOLATE SAFETY REGULATIONS AND NOBODY COULD SUE ME —EVEN OVER A BIG ACCIDENT!
I COULD DO THIS TO THE PUBLIC—ALL THE WAY TO THE BANK!
A CHIP OFF THE OLD BLOCK!
DEP'T OF ENERGY

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THE MILWAUKEE JOURNAL

Nuclear Liability

The Price-Anderson Act

What would happen if a major fire, accompanied by a nuclear chain reaction at Rocky Flats, contaminated surrounding homes and property with radioactive fallout, spreading death and disease? Who would pay for such a disaster?

Not the nuclear contractor. Rockwell would not have to pay, even if such an accident resulted from gross negligence.

Taxpayers would have to pick up most of the tab, because the DOE is responsible for up to $7 billion for nuclear accidents. But it is quite likely that damages would greatly exceed this amount, in which case homeowners would simply be unable to collect. Concerned property owners cannot prepare for such a contingency beforehand by buying nuclear insurance, because no insurance agencies sell it.

Nuclear contractors maintain a unique position of immunity from the ominous financial risks of operating their facilities because of the 1957 Price-Anderson Act. This legislation was originally intended to promote the "peaceful atom" by helping the infant nuclear power industry get on its feet. For a decade, the government agreed to assume liability for nuclear power plant accidents. After that time, bill supporters expected the nuclear industry to be financially capable of carrying its own insurance. But instead of expiring in 1967, the act was renewed for another decade and expanded to cover nuclear weapons factories like Rocky Flats.

Congress renewed the Price-Anderson Act again in 1977. When it expired in 1987, some legislators tried to amend it to increase contractor responsibility for safety at nuclear facilities. In the Senate Energy Committee, Sen. Howard Metzenbaum, D-Ohio, proposed an amendment that would allow full recovery of damages for accidents resulting from the contractor's gross negligence. The amendment was narrowly defeated in committee, with Sen. Tim Wirth voting in favor of the amendment.

When the committeesettled on a compromise to fine contractors $30 million for willful safety violations resulting in an accident, DOE fought back. It called a meeting of its twelve largest contractors, who sent letters to the committee, threatening to stop operating their plants unless penalty provisions were removed.

Rockwell's letter to the committee states: "The broad scope of [Price-Anderson] indemnity provisions, which cover any public liability that could arise from a nuclear incident, has been a key factor in Rockwell's interest in serving as the management contractor for the Rocky Flats Plant. . . . Terms such as 'gross negligence' or 'willful misconduct' . . . would inject great and unacceptable uncertainty into indemnity coverage."[34]

Fearing a lengthy floor debate, the Senate postponed the decision to extend the Price-Anderson Act, effectively allowing indemnity coverage to expire in August 1987, when the act ran out. Despite nuclear contractors' threats to halt production, those contracts that expired after that date were renewed under a different piece of legislation, Public Law 805804. This law guarantees limited indemnity coverage, excluding cases of intentional misconduct or bad faith on the contractor's part.

The Rocky Flats contract expires on December 31, 1988. By that time, Washington analysts expect the Price-Anderson Act will have been renewed, either in its present or in an amended form. A similar bill containing no indemnity exclusions has already passed the House floor.

As it now stands, the Price-Anderson Act places nuclear contractors in a unique position in the industrial world. If any other corporation operates in an unsafe, irresponsible manner, its insurance premiums rise. Federal nuclear contractors are shielded from this risk-minimizing mechanism. Regardless of the type of mistakes these contractors make, taxpayers and homeowners will pay for the damage.

Worker Safety

In the private sector, the Nuclear Regulatory Commission (NRC) has authority over radiological matters, and the Occupational Safety and Health Administration (OSHA) regulates workers' non-radiological health and safety concerns. But in nuclear weapons factories the DOE must both meet production quotas and hear worker complaints. The conflict between these two tasks has resulted in an ambivalent attitude on the part of DOE in enforcing safety regulations on the contractors. Some examples include:

—June 9, 1980: A Rocky Flats employee reported an improperly installed glove box filter to his supervisor, For three days authorities refused to investigate the issue, and employees were exposed to radiation. On June 12 the area around the glove box was checked and found to be contaminated. The glove box was shut down, and respirator protection prescribed.

Three weeks later, the worker who had filed the complaint was told that DOE could not substantiate the alleged delay and that safety was the responsibility of Rockwell, not DOE.

—August 5, 1980: DOE received results of another complaint, alleging that workers in a glove box operation were routinely exposed to contaminated air that exceeded allowable radiation levels. DOE had recently received a Rockwell investigation which documented fourteen incidents of contaminated air in that specific area. Nevertheless, DOE informed the worker that, although there were some deficiencies, the containment system and procedures were adequate to ensure the safety and health of employees.[32]

Pat Kelly, a spokesperson for the Steelworkers Local 8031, which represents about half the Rocky Flats work force, says that safety has always been a major focus of the union. Kelly says there have been hundreds of incidents in the course of operations that have resulted in worker contamination.

One of the most common types of exposure results when plutonium punctures the rubber gloves, worn by workers while handling the metal, cutting and exposing fingers.

The number of such incidents has risen substantially since 1981 as a result of a major increase in production, Kelly says. Employee complaints regarding unsafe working conditions have risen steadily during each year of the Reagan Administration, from 40 cases in 1980 to 200 in 1986.[35]

Kelly also complains that Rocky Flats management has been negligent in supplying workers with prompt and accurate information regarding exposure to radiation. After an unusual occurrence, workers send a urine and fecal sample to the lab to be tested for internal contamination. An increasing number of these samples have been lost in transit or contaminated during analysis. Management has also been delinquent in informing workers of the results of these tests. In some cases employees have been informed months later that a test was invalid. It is questionable whether a second test at that time would accurately reveal the extent of internal exposure.

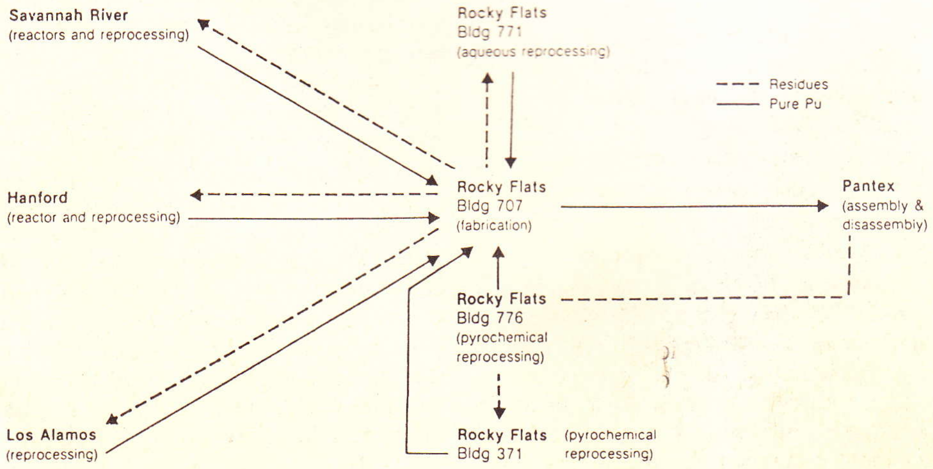
Kelly stresses that he has faith in the abilities and integrity of the technicians working in the laboratory, some of whom are members of the union. The lab technicians only analyze the samples, however, and then pass the data to Rockwell authorities, who give workers their test results. Kelly contends that health information is bottlenecked by management after it leaves the lab. Because of these allegations, the Steelworkers have requested that urine and fecal samples following a nuclear incident be tested by both the onsite lab and an independent testing facility.

Worker Suits

Rocky Flats workers who contract cancer after being exposed to radiation on the job have a hard time winning compensation for themselves or their families. This is due to Colorado worker compensation laws, which stipulate that a plaintiff must prove that the injury or death was work-related in order to receive compensation.

For cancer victims, the burden of proof is far more problematic then for workers involved in other industrial accidents. The latency period for cancer, which can be as long as 30 years, means that workers often have to rely on very old records to prove exposure. They then have to take on the formidable debate over whether exposure to low-level radiation causes cancer. Plaintiffs often find themselves relying on evidence from laboratories owned and managed by the defendant — the DOE.

Bruce DeBoskey, a Denver attorney who has represented a number of worker's compensation cases against Rocky Flats operators, has shown that these obstacles can be overcome. In two landmark cases, Deboskey won compensation for the families of two plant employees who had died of cancer. He has also lost two cases but expects a third victory soon. Five other cases are pending (as of August 1987).



The Compliance Agreement

Litigation in 1984 ended the Department of Energy's self-regulation over mixed waste, transferring this authority to the Environmental Protection Agency (EPA). Mixed waste includes hazardous substances contaminated with small amounts of radioactive substances. Purely radioactive waste remains under the jurisdiction of the DOE.

In Colorado, the EPA agreed to work in conjunction with the Colorado Department of Health (CDH) to investigate mixed waste at Rocky Flats. Together, the two agencies would attempt to bring transportation, storage, and disposal practices at the plant into compliance with the law.

DOE and Rockwell tested the new laws, refusing to recognize the jurisdiction of the EPA or the health department. In November 1985, Rocky Flats operators notified CDH that they were handling certain wastes, but they did not mention any radioactive mixed waste streams, claiming the health department had no jurisdiction over these.

State health officials called the bluff. A month later CDH issued a notice of intent to deny Rockwell a permit application, effectively threatening to close Rocky Flats' waste management operations. If the plant could not process waste, it could not function long. This was a precedent-setting move — by far the most aggressive stance ever taken by a state health agency toward a federal nuclear bomb factory.

The dispute seemed destined to turn into a major court battle. But DOE proved eager to settle out of court. An internal memo, intended to brief the DOE official who was negotiating an agreement with CDH and EPA,[36] clarifies DOE's willingness to compromise.

This memo states: "The compliance posture of the Rocky Flats facility makes it a poor candidate for testing fine points of the law. . . . We have basically no RCRA groundwater monitoring wells, our permit applications are grossly deficient (some of the waste facilities there are patently 'illegal'). We have serious contamination, and we have extremely limited environmental and waste characterization data for a site of this complexity."[37] Fearing that court proceedings might publicize the the appalling conditions at the site, DOE decided to negotiate.

By signing the Compliance Agreement, DOE recognized the jurisdiction of both EPA and CDH over mixed wastes at Rocky Flats. In return, the two monitoring agencies agreed to waive all civil penalties against DOE or Rockwell for any mixed waste violations that had take place prior to July 31, 1986, when the agreement was signed.

DOE officials apparently decided that maintaining a positive public image was more important than the right to self-regulation. The memo points out that "Failure to bring the [Compliance Agreement] to fruition would set back, if not destroy, the credibility of the Secretary [of Energy]'s environmental program." Additionally, the agreement provided a "sufficient degree of vagueness and ambiguity" to ensure that EPA would not be able to issue "orders" to the Rocky Flats facility, according to the memo.

Both the EPA and CDH maintain the right to sue DOE for violations after the agreement takes effect. Private citizens can also use the agreement as a basis for suits. This danger is recognized in the DOE memo: " . . . from the legal side there are the risks associated with the theoretical success of a citizen suit based on the agreement."

This fear turned out to be well founded. Within a year, The Sierra Club and the Citizens Against Rocky Flats Contamination had filed a suit against DOE and Rockwell International because of a proposal to incinerate radioactive mixed waste at the plant.[38]

Incineration at Rocky Flats

While the lawsuit over the mixed waste incinerator brings a new twist into the debate over Rocky Flats, incineration at the plant has a long history. It began in the 1950's when the plant burned depleted uranium chips in open pits. Since then incineration has served two purposes: to recover reusable plutonium, and to dispose of non-reusable wastes.

The recovery incinerator, located in building 771, is permitted to burn as much as 168 tons per year. The waste disposal incinerator, located in building 776, is not being used currently, but according to a new proposal it could start burning 200 tons of liquid and solid waste per year. Built in 1978, it was operated for three years, shut down, and then used again in 1985. Rockwell initially claimed the incinerator had never been used but later admitted it had been working for a three-year period.3[9]

In 1986, because of the Compliance Agreement, the type of wastes to be burned in the new incinerator fell under the regulation of CDH. The health department voluntarily held public hearings as part of the permit-granting process. This brought on a wave of controversy; there followed more than 2000 letters from the public, many questions to Rockwell from the EPA, CDH, Senator Tim Wirth and Representative David Skaggs, and the establishment of two scientific panels to study the incineration. The controversy culminated in the Sierra Club lawsuit against DOE and Rockwell.

As part of the permit application process, Rocky Flats operators had planned a trial burn for the mixed waste incinerator, during which the system would be tested before beginning full-scale operations. But questions about the safety and integrity of the trial burn led to several postponements in early 1987, the last one for an indefinite period.

Mixed Waste Disposal

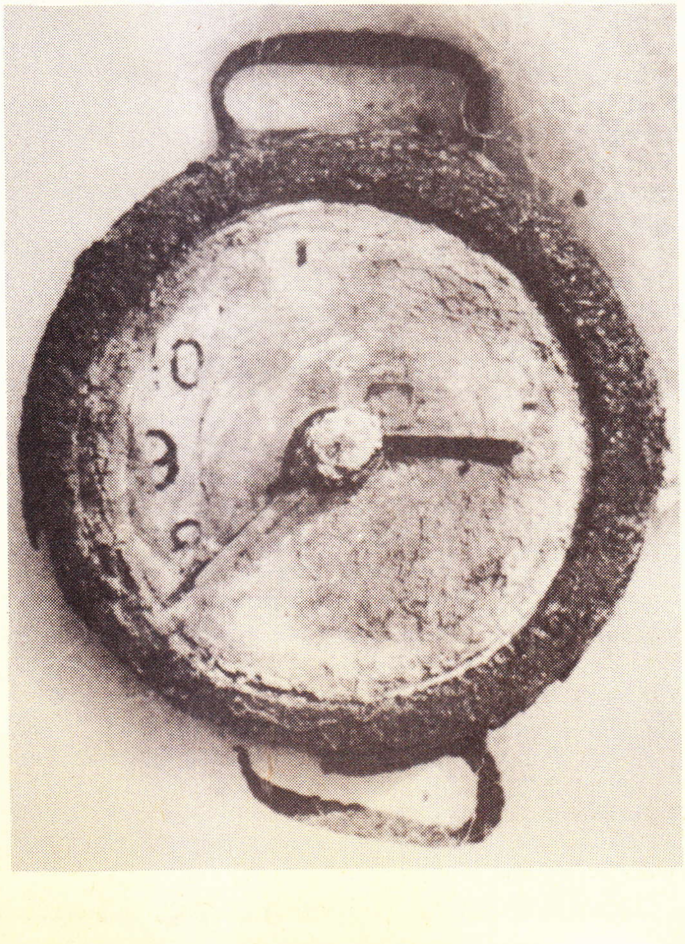
The waste incinerator would burn a mixture of low-level radioactive material, such as plutonium and uranium, and hazardous chemicals, mostly oils and organic solvents. Only low-level wastes are allowed, which means the wastes must contain less than 100 nanocuries of radioactivity per gram.

These wastes — often mixed with more radioactive substances — had previously been buried onsite or at the Idaho National Engineering Laboratory (INEL) near Idaho Falls. Liquid mixed wastes were solidified and shipped to the Nevada Test Site near Las Vegas. Due to new interpretations of disposal laws, low-level wastes must now be separated from the more radioactive, or transuranic wastes. Transuranics are being sent to a repository at INEL for eventual disposal in New Mexico, but there are no facilities to dispose of low-level mixed wastes. The Nevada Test Site does not have a permit to receive them, and the Department of Transportation has no authorized container to ship them in liquid form. For these reasons, Rocky Flats has chosen onsite incineration as the preferred method of disposal.

Burning the wastes would reduce the volume by about 95% while eliminating the chemical toxicity by oxidation. Converting them to ash and cementing them into blocks would make them easier to handle.

The Mixed Waste Incinerator

The incinerator consists of a feed screw and two combustion chambers. The first chamber, starved of oxygen, burns mostly chlorine and sulfur compounds, while the oxygen-rich afterburner burns organic and hydrogenated compounds. The temperature of the chambers is about 1000° F — low enough that combustion is flameless. A catalyst in the combustion chambers neutralizes hydrochloric acid. Temperature and



Time stopped by Atom Bomb. The Hiroshima explosion recorded at 8:15 a.m., August 6, 1945 on the remains of a wrist watch found in the ruins in this 1945 United Nations photo. The shadow of the small hand on the 8 of the watch was burned in from the blast, making it appear to be the big hand.

pressure monitors are set to shut off the feed screw automatically if they detect conditions outside the proper operating range. The output of the incinerator is mostly water vapor, carbon dioxide, other gases and solid ash.

During the proposed trial burn of the incinerator, Rockwell would first burn nonhazardous wastes, followed by hazardous wastes, and finally materials spiked with a maximum of 0.04 ounces of plutonium per ton. The process would be interrupted at any of these stages if the incinerator did not function properly. If the trial burn demonstrates that the incinerator can operate safely, it will be used to dispose of backlogged mixed waste. According to Rockwell reports, the actual wastes to be burned are typically only one percent as radioactive as those proposed for the trial burn.

What would happen to plutonium in the incinerator? Burning in the combustion chamber, it would form small plutonium oxide particles, some of which would be carried away by gases; others would be trapped with the ash. Two high-efficiency particulate air (HEPA) filters, located at the output of the incinerator, would trap most of these particles. The gases exiting the incinerator would then pass through four more HEPA filters before leaving the building. Each of these six filters removes more than 99.9% of the particles from the gases passing through.

Opposition to the Mixed Waste Incinerator

Some opponents of incineration fear any increase in plutonium releases from the plant, no matter how small. Others are particularly concerned about accidents, especially those that might breach the HEPA filters, releasing many respirable plutonium oxide particles into the air. They point to shortcomings in the monitoring system, which might not detect an accident until too late.

For example, the monitor for radioactive emissions, located in the incinerator's stack, has a response time of one hour. If levels are too high, it sounds an alarm in the control room. An investigation then takes place before the incinerator is turned off.[39]

In the event of a fire, the operator is supposed to push a stop button and telephone the fire department. Meanwhile, high temperatures could destroy the filtering system (the 1957 fire blew out all 600 HEPA filters). Although temperature monitors would probably shut off the waste fed into the first combustion chamber, all the material already in the incinerator could continue to burn, sending unfiltered gases into the environment.

The Sierra Club and Citizens Against Rocky Flats Contamination have charged that plant officials have not examined alternatives to onsite incineration, and that an adequate assessment of the environmental consequences of the burn has not been done. Both of these are required, according to their suit, under the National Environmental Policy Act.

This suit could set an important precedent. Such cases pressure DOE and its contractors to take health and environmental concerns seriously. The opportunity to subpoena relevant information for such a suit can yield valuable information about the plant, which might not otherwise be obtainable.

For example, most of the information now known about the 1957 fire was revealed in the course of a suit brought by landowners against Rocky Flats operators. Claiming the fire had severely contaminated their property, the plaintiffs were able to subpoena documents and worker testimony about the accident. At the end of the trial, the DOE tried to retrieve all documents related to the fire for shredding. Luckily, some documents escaped this fate.

Oversight at DOE's Nuclear Facilities

Everybody knows what happens when a teacher asks students to grade their own papers. The same is true for government agencies. The position of DOE as a self-regulator has resulted in a very grave situation that is by no means limited to Rocky Flats. A 1981 General Accounting Office report asked and answered the following questions about DOE's nuclear weapons facilities:

Is DOE's program adequate to assure the employees at DOE's nuclear facilities are provided with safe and healthful working conditions?

— The short answer is "No."

Is DOE providing adequate emergency preparedness . . . assuring that DOE facilities are prepared to respond to nuclear accidents?

— The short answer is "No."

How does DOE assure itself that information concerning radiological releases from DOE's nuclear facilities is accurate and reliable?

— GAO's answer is that DOE has little assurance.[42]

The report concluded that a separate high-level office was needed within DOE to oversee safety and health. Although DOE disagreed with this recommendation, such an office was established in 1985, but its budget is controlled by the weapons production office.[43]

Believing internal oversight to be inherently inadequate, the GAO also recommended outside, independent reviews,[33] to which DOE responded: " . . . an additional level of oversight . . . would not provide any additional assurance of the safe operation of DOE facilities . . . "[44]

The DOE's recalcitrance has prompted some legislators to propose direct oversight of various DOE activities. One important area of study has been health research on the effects of radiation. In 1985, then-Representative Tim Wirth introduced a bill to transfer authority to conduct such research from DOE to the Department of Health and Human Services. Wirth stated, " . . . the federal agency performing the bulk of this research is the same agency which has responsibility for operating and promoting nuclear weapons facilities . . . .This conflict of interest casts doubt on the objectivity of the Department's research and on its interest in worker safety and health."[28]

In 1988 Senator Glenn introduced a much broader oversight bill, S 1085.[45] This bill would:

—establish an independent Nuclear Safety Board. This would have access to DOE facilities and records as well as authority to require DOE to address the board's findings and recommendations;

—give the EPA regulatory authority over mixed wastes (both hazardous and radioactive);

—apply the standards of the Occupational Safety and Health Administration (OSHA) to workers at DOE plants. DOE is currently exempt from regulation by both OSHA and the Nuclear Regulatory Commission; and

—establish an independent research board to review all research on the effects of radiation on the human body.

The third provision has been most actively contested by the DOE but finds strong support among local Steelworkers Union members. If enacted, it would grant OSHA officials the specific "right of entry for unannounced inspections without probable cause" and the authority to receive complaints from individuals. This stipulation would protect workers filing complaints from retribution.

At this time (Feb 1988) S 1085 has not yet come before the Senate.

Police jump from a train carrying radioactive materials into Rocky Flats to arrest demonstraters sitting on the track. (Robert Godfrey)

Protest at Rocky Flats

For the first twenty years of its history, Rocky Flats operated in relative obscurity, with the surrounding community taking little notice. Most people living near Rocky Flats knew very little about the plant or the hazards associated with it. In fact, Denver residents did not learn that Rocky Flats was manufacturing nuclear triggers until three years after it became operational.

Opposition to the plant began to grow in the early seventies. Citizens Concerned about Radiation Pollution (CCARP), a group that had been protesting underground nuclear testing in Colorado, took soil samples from the Rocky Flats perimeter in 1970, which they presented to local political candidates for analysis. Other groups took up the cause, and within five years the Denver community was becoming familiar with the Rocky Flats issue.

Local religious groups, such as the American Friends Service Committee and the Catholic Peace and Justice Office, joined the campaign in the mid-seventies, holding vigils and demonstrations. In 1974 a coalition of these and other groups formed the Rocky Flats Action Group. This coalition educated area residents by sponsoring community meetings and workshops, organized rallies and published "Local Hazard/Global Threat," an educational pamphlet.

Opposition to Rocky Flats intensified dramatically in 1978. The "year of disobedience," as it was later called, began with a demonstration of 5000 in April. A symbolic blockade at the end of the demonstration developed into a campaign of civil disobedience that lasted a full year. Protesters set up a camp on the railroad tracks leading into Rocky Flats, blockading train traffic. Within a year, over 500 arrests had been made at this blockade. When the costs of arrest, incarceration, and prosecution rose to more than $150,000, Jefferson County officials attempted to collect $5 million in property taxes from Rockwell to cover expenses. Rockwell refused to pay.[46]

Demonstrations against nuclear weapons became a familiar sight in the coming years, as the freeze movement grew into a huge national campaign. Locally, this movement culminated on June 9, 1982, when 30,000 people turned out at the state Capitol to rally for nuclear disarmament with singers Jimmy Buffet, Judy Collins and John Denver.

The largest onsite demonstration in Rocky Flats history occurred on October 15, 1983, as protesters gathered in an attempt to encircle the entire facility by linking arms. About 20,000 people lined the 17 mile perimeter of Rocky Flats, holding hands and singing.

Not all Rocky Flats demonstrations have been anti-nuclear. Supporters of nuclear weapons and nuclear power gathered in large numbers in August 1979 to wave U.S. flags and cheer patriotic speakers. Some Rocky Flats workers joined with the

Citizens for Energy and Freedom to sponsor the event, which drew about 10,000 people. The Boulder *Daily Camera* described the rally as having "the air of a large Fourth of July picnic."[47]

Since the train blockade of 1978, numerous campaigns of Civil Disobedience have augmented more legal forms of opposition to Rocky Flats. The most recent of these actions took place on Nagasaki Day, August 9, 1987. Protesters attempted to blockade the plant, resulting in 316 arrests.

Most of those arrested over the years at Rocky Flats have been released with fines or suspended sentences, but some have also served time. Roman Catholic nuns Patricia Mahonie and Ann Marie Nord, for example, served six months of a five year sentence for using fake I.D.s to enter Rocky Flats in 1982. After driving past the guards, the two women hoisted a flag over the main complex that read, "Death Factory."

Nord explained the concept of civil disobedience to the judge after being sentenced: "Clearly, the common good is at stake here, and if the law is not for the common good of the people, then you must break it. I'm not one bit sorry."[48] Mahonie was just as unrepentant. She returned to Rocky Flats to trespass in 1984 and served another six months in jail for that offense.

Demonstrations and civil disobedience are not the only methods citizens have to challenge the continuation of Rocky Flats operations. Lobbying campaigns to legislative representatives, educational programs for local residents, and outreach to Rocky Flats workers have all played an important role in citizen opposition to the plant. And in 1982 activists brought a ballot initiative to Colorado voters that would have established a fund to study conversion options for Rocky Flats. The initiative was defeated, but 38 percent voted in favor.[49]

Perhaps the most persevering opponents of Rocky Flats are those who wage the battle on a spiritual level. Every Sunday afternoon since 1978, the west gate of the plant has served as an interdenominational meeting place for a prayer vigil — through snowstorms, heat waves and heavy rains.

The Future of Rocky Flats

Many people now agree that it was a mistake to locate Rocky Flats near such a large metropolitan community in the first place. But as aging plant buildings deteriorate, officials must now decide on the plants' future. Should they spend money to upgrade the facility as it is or invest in relocation alternatives instead? Whichever path is chosen, a lively stream of government studies is sure to follow. The GAO has issued more than fifty reports on various safety aspects of DOE's nuclear weapons facilities — seven of which were specifically related to Rocky Flats.

Options for the future include:

Business as usual

The continuation of Rocky Flats operations will probably augment the current contamination and its associated health risks. Plant operators have a history of disposing of wastes in the cheapest way available. This, along with a series of accidents, has resulted in considerable offsite soil contamination. Groundwater pollution, though currently confined to the site, also presents a serious environmental hazard that will be difficult and expensive to remedy. Although DOE and Rockwell face growing pressure to clean up the site, their past denials of contamination and its dangers inspire little confidence.

Taxpayers must also question whether programs to upgrade deteriorating buildings are financially efficient. The history of building 371, designed to modernize plutonium processing at Rocky Flats, is illustrative. It was expected to cost $113 million and be done in four years, but took twice as long and cost twice as much. It has operated at only 7 percent capacity since it came on line in 1981. And now DOE plans to spend another $300 million on a seven-year campaign to bring the building up to 45 percent operating capacity.[1]

Relocation

In 1975 the Lamm-Wirth Task Force recommended that Congress and the President consider " . . . phasing out [Rocky Flats'] present operation, . . . decontaminating and converting the Plant's facilities to a less hazardous energy-related industry, . . . [and maintaining] the economic integrity of the Plant, its employees, and the surrounding community."[9]

Twelve years later, the General Accounting Office again examined the costs of relocating all or part of the plutonium operations from Rocky Flats to some other DOE facility. Relying on DOE studies, the GAO reported that total relocation would cost $4 billion and take 24 years. It would cost about $300 million just to decontaminate the Rocky Flats site.[1]

The GAO report also noted that the socioeconomic impact of relocation on the Denver area would be small. Because relocation would take a long time, the work force would be dismantled at a slow, steady rate, making it easier for workers to find reemployment.

Senator Tim Wirth, who commissioned the 1987 GAO report, favors a partial relocation option. Wirth would like to see plutonium manufacturing operations remain at Rocky Flats, but plutonium recovery moved to another DOE facility. This $500 million plan would take about nine years and cut the accident risk and the amount of waste generated by half.

Relocation schemes promise less worry to Denver metro residents. But they also bring new headaches to the neighbors of whichever facility adopts the plutonium operations. From this perspective, relocation only means dumping a local problem in somebody else's backyard.

Shutdown/Conversion

Without a nuclear trigger factory, the arms race cannot continue. But even a nuclear freeze would not eliminate the need for Rocky Flats because aging, unreliable bombs would need to be rebuilt. Disarmament is the only alternative that would put an end to the operations that now take place at the plant.

Disarmament is not only a way to stop Rocky Flats from poisoning the Denver area, but also an important goal in its own right. The plutonium triggers produced at the plant are far more threatening than the plant itself. If they are ever used, the destruction will not be limited to the area surrounding Rocky Flats. The fate of the plant is not just a local concern. The survival of the entire planet may depend on it.

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Glossary

alpha particles - energetic particles, composed of two protons and two neutrons, given off by some radioactive substances as they decay. Plutonium-239 gives off alpha particles.

americium - a radioactive chemical element. Americium-241, a decay product of plutonium, is 50 times as radioactive as plutonium-239. Nearly all the americium used in the United States is manufactured at Rocky Flats.

beta particles - less energetic than alpha particles, these are actually electrons emitted from a nucleus. Plutonium-241 emits beta particles.

CDH - Colorado Department of Health. Agency with jurisdiction over the mixed waste generated at Rocky Flats.

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. 9601). The "Superfund" cleanup for abandoned or uncontrolled waste sites. EPA implements CERCLA and may not delegate its jurisdiction to the states (as it can with RCRA).

curie - a unit of radioactivity; the quantity of any radioactive substance that undergoes 37 billion disintegrations per second. For Plutonium-239, one curie is 15.6 grams. Successive divisions of the curie by factors of 1000 are:

kilocurie - 1000 curies. The 1957 fire burned about a kilocurie of Pu.

curie - about 5 curies of Pu have been found on public and private land since Rocky Flats began operations.

millicurie - one thousandth of a curie. The contamination of the soil near the state capitol building is about one millicurie per square mile.

microcurie - one millionth of a curie. The plutonium release from Rocky Flats is about one microcurie per month.

nanocurie - one billionth of a curie. Current radiation standards set the total lifetime permissible body accumulation of plutonium at 40 nanocuries.

picocurie - one millionth of a millionth of a curie. One picocurie provides 2.2 disintegrations per minute (dpm).

DOE - U.S. Department of Energy. A cabinet department of the executive branch that owns and oversees the Rocky Flats plant and seventeen other facilities around the nation that produce nuclear weapons and fuel for naval vessels. The DOE succeeded the Energy Research and Development Agency in 1977, which succeeded a branch of the Atomic Energy Commission in 1974.

EPA - Environmental Protection Agency. Implements federal legislation to protect the environment, such as the Clean Air Act, the Clean Water Act, RCRA, CERCLA, and NEPA.

GAO - General Accounting Office. The investigative arm of Congress, independent of the executive departments.

half-life - the length of time it takes half of a radioactive substance to decay to other elements. The half-life of Pu-239 is 24,100 years, during which it changes to uranium. The half-life of Pu-241, which changes to americium, is 14 years. The more radioactive an isotope is, the shorter its half-life.

isotope - any of several forms of a chemical element, differing in the radioactive properties of its nucleus (such as half-life), and designated by a number (the atomic weight) after the element's name or symbol; such as: Pu-239 or Pu-241.

plutonium - (symbol Pu) a chemical element produced in nuclear reactors, capable of releasing great energy when induced to fission.

RCRA - Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6901). The act regulates the management and disposal of hazardous waste. EPA normally implements RCRA but may authorize a state to do so, as has been the case in Colorado.

rem - a unit of radiation that causes a given amount of biological damage. The primary safety standard is five rem per year for workers and a half rem per year for the general public.

transuranic waste - waste containing plutonium, americium, or some others, that has a radioactivity concentration greater than 100 nanocuries per gram.

Chronology of Events at Rocky Flats

1945 World's first nuclear war culminates with the explosion of the first plutonium bomb over Nagasaki, August 9.

1951 Rocky Flats established by the Atomic energy commission to build plutonium "triggers" for nuclear bombs.

1953 Bomb production begins at Rocky Flats under contract with Dow Chemical Company.

1957 Fire and explosion in building 771 burns more than 100 curies (35 lbs) of plutonium and all protective filters. No one knows where the plutonium went.

1954 Waste drums leak radioactive waste onto open field for the next twelve years. Leakage discovered in 1959 and admitted in 1970. Winds redistribute contaminated soil particles throughout the Denver metro area.

1964 Employee's fingers amputated because of exposure to plutonium chips.

1966 Drums which leaked radioactive waste and contaminated soil particles throughout the Denver metro area are finally removed.

1969 Plutonium fire in building 776 causes $45 million damage.

1973 About 1000 curies of tritium released to the Broomfield water supply.

1975 Rockwell replaces Dow as operator of Rocky Flats. Lamm-Wirth task force report suggests relocating Rocky Flats operations.

1975 Landowners sue Rocky Flats for property contamination; suit settled in 1984 for $9 million.

1978 Civil disobedience campaign blocks trains into Rocky Flats. 500 arrested.

1979 Johnson's study fins excess cancer in Denver area residents related to Rocky Flats.

1981 Voelz mortality study finds healthy work force at Rocky Flats. Johnson's mortality study suggests otherwise.

1986 Crump study of cancer in Denver area resident corroborates Johnson's 1979 data but concludes that Rocky Flats is not the cause.

1986 Compliance agreement between DOE,EPA, and CDH regulates disposal of mixed hazardous and radioactive wastes. Phase I of DOE cleanup program begins.

1987 Wilkinson's mortality study finds excess cancers among Rocky Flats workers exposed to only 5% of the radiation protection standard.

1987 Incineration of radioactive mixed waste delayed more than a year by combination of public protest, equipment problems, Health department vigilance, legislative concern, and citizens' suit.

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Created in a spirit of unconditional nonviolence, the Rocky Mountain Peace Center is dedicated to research, education, and action in nonviolence as a means of personal and social change and to the achievement of justice by nonviolent means.